

The most important thing we build is trust.

Messenger Smart Receiver (MSR)

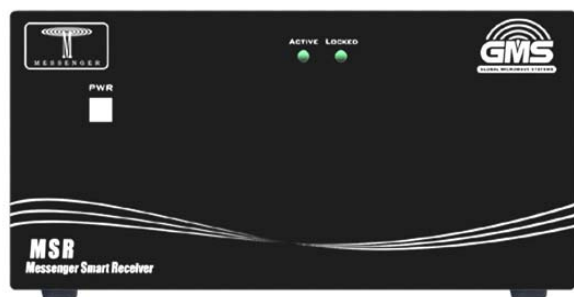


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Acronyms

This section lists and describes the various acronyms used in this document.

Name	Meaning
16 QAM	16-State Quadrature Amplitude Modulation
64 QAM	64-State Quadrature Amplitude Modulation
A	Amperes
A/V	Audio/Video
AES	Advanced Encryption System
ASI	Asynchronous Serial Interface
BDC	Block Down Converter
COFDM	Coded Orthogonal Frequency Division Multiplexing
CVBS	Composite Video
D/C	Down-Converter
DVB-T	Digital Video Broadcasting - Terrestrial
FEC	Forward Error Correction
GUI	Graphical User Interface
I/O	Input/ Output
Kbaud	Kilobaud per second
Kbps	Kilobits per second
LO	Local Oscillator
Mbps	Megabits per second
MDL	Messenger Digital Link
MDT	Messenger Digital Transmitter
MSR	Messenger Smart Receiver
MER	Modulation Error Rate
MPEG	Moving Picture Experts Group
NTSC	National Television System Committee
PAL	Phase Alternation Line
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RX	Receiver
S/N	Signal-to-Noise Ratio
SPI	Parallel Transport Stream
THD	Total Harmonic Distortion
TS	DVB MPEG Transport Stream
TX	Transmitter
VAC	Volts (Alternating Current)
VDC	Volts (Direct Current)

1 Introduction

GMS' Messenger Smart Receiver (MSR) System is a VHF/UHF DVB-T Receiver with several powerful and unique features. When used in conjunction with GMS' Block Down Converters (BDC), the MSR can cover frequency bands exceeding 7 GHz. The first unique feature is Multiple-Input Maximal-Ratio Diversity Combining, up to six independent receive paths per MSR.

Another feature is the MSR's Doppler handling ability. Multiple MSRs can be linked together to form very large Diversity systems. Unlike conventional DVB-T systems, the MSR is designed for mobile environments. With 2 K carriers and 16 QAM, a dual-input or greater MSR can handle greater than 570 Hz of Doppler frequency shift, which equates to 708 mph (1 140 km/h) @ 504 MHz carrier frequency. With 8 K carriers and 16 QAM, a dual-input or greater MSR can handle greater than 125 Hz of Doppler frequency shift, which equates to 155 mph (250 km/h) @ 500 MHz carrier frequency. This feature is an enabling technology for COFDM based Helicopter and UAV links.

This manual provides information on how to operate the MSR as well as pertinent technical information related to the overall system.

Important --- Please refer to "User Notice" for updated operational limitations.

1.1 Key System Features

- Robust Link Performance with COFDM
- Multi-Input Diversity Maximal-Ratio Combining
- Provide superior coverage in the toughest reception areas
- Enhanced Doppler performance for tracking moving vehicles
- ASI output supports a wide variety of external decoders
- 49 MHz to 7 GHz (In-Bands) with Optional Internal or External Down - Converters

2 Theory of Operation

The MDL system utilizes a robust digital modulation system known as COFDM that provides frequency diversity and powerful Forward Error Correction (FEC) algorithms. The end result is a robust wireless link that is effective against multipath interference experienced by analog systems, and provides crisp, clear pictures in the most difficult of terrains.

The MSR receives and demodulates a DVB-T signal and recovers the DVB MPEG-2 transport stream containing the digital video, audio and ancillary data. This stream can be optionally encrypted with a 128-bit Advanced Encryption System (AES) to provide protection in sensitive applications. The recovered Transport Stream (TS) is decrypted (Option sold separately) and converted to Asynchronous Serial Interface (ASI) and SPI Parallel Transport Stream (SPI). The ASI and SPI are output from the back panel of the MSR.

External Audio/Video/Data Decoders are sold separately that support SD and HD MPEG-2 4:2:0 and/or 4:2:2, H.264, AVC and any other format that can be transmitted in a transport stream. LAN IP streaming interfaces are also available from GMS to support distribution of the Wireless Audio/Video/Data anywhere in the world via the Internet. This system architecture supports single or multiple programs by looping the ASI interface to multiple Decoders.

The MSR is normally used with GMS' optional Block Down-Converters (BDCs) to provide frequency coverage from 862 MHz to 6 GHz. GMS' BDCs can be mounted remotely, normally right at the antenna output (optimizing system performance) or within the MSR chassis. When remotely mounted, BDC power can be provided via the IF coax cable. The MSR' MS Windows Control SW provides independent control of the power to each BDC.

A single MSR with internally mounted BDCs, can support up to 4 independent antennas. With external BDCs, each single MSR can support up to 6 independent antennas. The system automatically configures itself for inputs from 1 to 6 per MSR. Both even and odd configurations are supported.

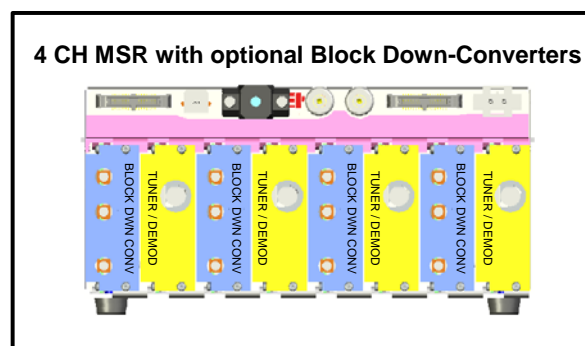


Figure 1 Four CH MSR w/optional BDCC-s

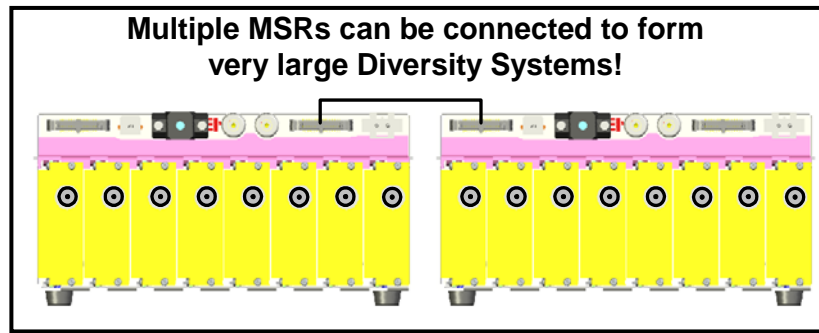


Figure 2 Chained MSRs

The MSR can provide autonomous acquisition, tracking and recovery. However, it was designed to be controlled via an IBM PC using a Window's-based control program. The program provides control of the center frequency, COFDM bandwidth, BDC power, and the acquisition mode of the system. All other modulation parameters, including spectral inversion, are automatically detected and set during the acquisition process. Once locked onto the signal, the MSR Control SW provides an extensive array of status information.

3 Getting Started

The MSR is pre-configured by GMS prior to shipment (based on customer requirements), thus is ready to work “right out of the box”.

NOTE: Additional cables and antennas may be delivered by GMS based on customer application. Contact GMS for further information.

3.1 Initial Checkout

Prior to installing an MSR unit into the desired target environment, an initial checkout should be performed to ensure proper operation of the unit.

Figure 3 shows a basic MSR system configuration. The steps necessary to setup the system configuration in Figure 3 are shown below.

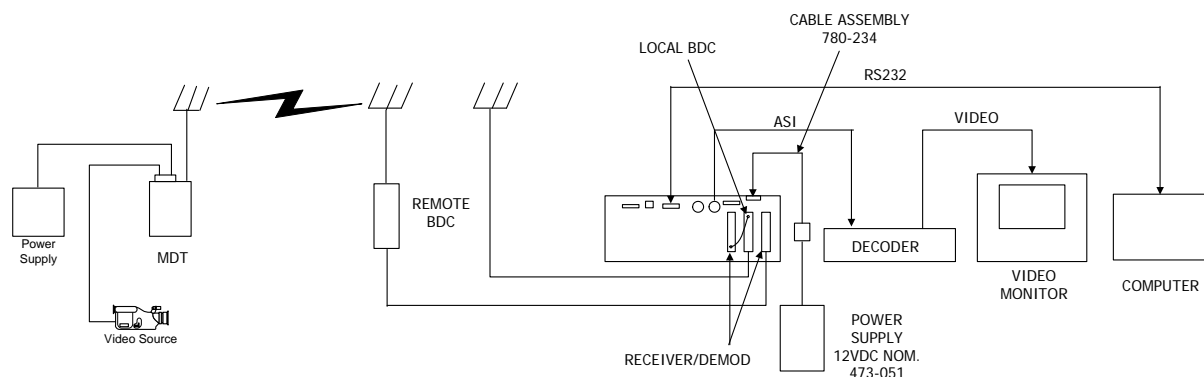


Figure 3 System Configuration two channels

- Install Omni-directional antennas onto the MDT RF output port. Install antennas on Remote BDC RF input port and local BDC.
- Attach the MDT breakout cable (DB-44 end) to the MDT unit.
- Attach a RF cable from the BDC output port to MSR IF of RX/Demod card.
- Attach a composite video source to MDT BNC video input cable that is located on the MDT breakout cable.
- Attach a video cable from one of the BNC video output ports on the Decoder to a video monitor.
- Apply +12 Vdc to the MDT unit using the red (+12 V) and black (ground) wires from the MDT breakout cable. NOTE: The power supply used needs to be able to provide at least 1 Amp of current at a nominal +12 VDC input.

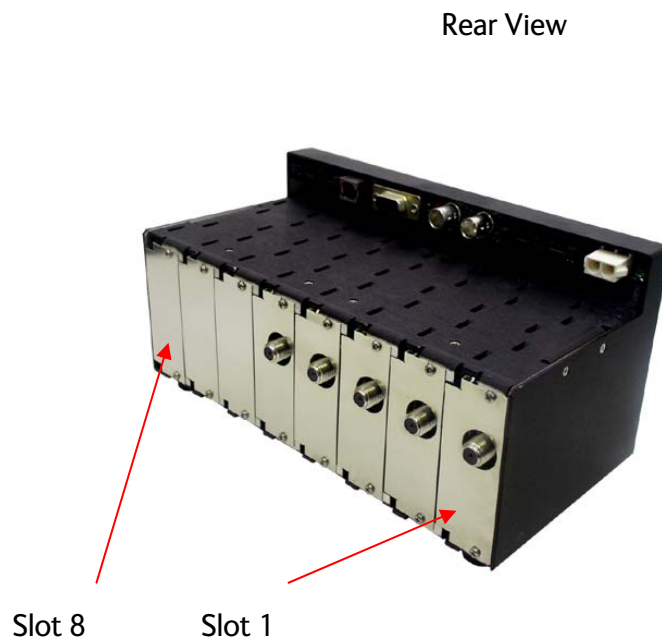
- Apply +12Vdc to the MSR, pins 1 (+12 V) and 2 (ground) to the 2 pin connector (P1). Power supply must be able to source up to 6 amps (when also powering external down converters). Cable assembly 780-C0242 is provided to make these connections.
- If an optional AC/DC Power supply is purchased (GMS # 473-051), attach the XLR connector (male) to the XLR connector (female) of cable 780-C0234. Attach the two pin Molex connector of 780-C0234 to P1 of the MSR chassis. (Ref. Figure 3). Plug in the AC plug of the power supply into an 115 VAC Outlet. See Appendix D for optional power supply.
- Turn on the video source and video monitor equipment.
- To turn on the BDC (down converter) from the front MSR control panel at the computer. See section 6.3 for details on powering the BDC.
- Set the RF Bandwidth & Center Frequency and then push “Tune” on the MSR’s control screen.
- After approximately 2-5 seconds, the link should be established and video provided by the source should be displayed on the monitor.

The initial checkout described above is simply to check the basic video operation of the MSR unit. For further details on monitoring and controlling the MSR, see section 6.3

4 Hardware Overview

The MSR’s versatile housing can sit on a desktop or be mounted with the optional 19-inch instrumentation rack-mount kit. It can be optionally supplied with a local control panel.

All interface connectors (Power, RS232, USB, ASI and SPI) are located on the rear of the MSR unit panel. The power on switch and two led indicators (System Active and ASI locked) are located on the front panel. The front and rear view of the MSR unit are illustrated in Figure 4.



Front View



Figure 4 Front/Rear views (with and without local control)

The MSR chassis is fitted with an active backplane motherboard consisting of eight 80-pin connectors. The motherboard is protected with a 2.5 amp resettable fuse. The MSR is designed to accept 9-15 VDC input power.

The 80 pin connectors on the motherboard can accept a Tuner/Demod card, a local BDCC card or a Digital Data Processor Card (DDPC). The system can be configured for various combinations of these cards. Slot 1 (first slot on the right), must contain a Tuner/Demod card if the system is going to be used for DVB-T reception. The remaining slots must use a slave Tuner/Demod filled incrementally from slot 2 to 6. The user can choose to use local or remote BDCs. A single MSR with internally (local) mounted BDCCs can support up to 4 independent antennas (4 Tuner/Demod and 4 BDCC cards). With remote BDCs, a single MSR can support up to 6 independent antennas (6 Tuner/Demod cards). The motherboard provides 8 independent 1 amp fuses to each card slot.

4.1 Tuner/Demod Card

The Tuner/Demod card receives and demodulates a DVB-T signal and recovers the MPEG-2 transport stream containing the digital video audio ancillary data. The output of a BDC (Local or Remote) is fed to the IF input of the Tuner/Demod card. The input frequency range is 49 to 862 MHz. Figure 5 shows a typical Tuner/Demod card.

IF Input (F Type Connector) Bottom Card Edge Connector

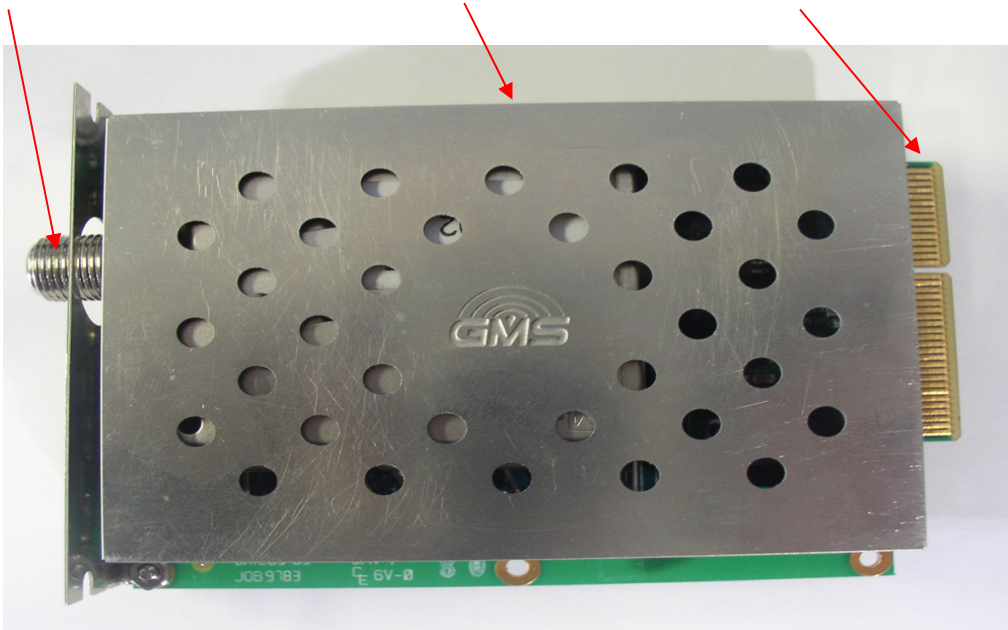


Figure 5 Tuner/Demod Card

4.2 BDCC Card

The Tuner/Demod card is capable of receiving frequencies in the range of 49 MHz to 862 MHz directly into the IF input. Frequencies above 862 MHz make use of the BDCC in which higher frequencies are down converted into the range of frequencies between 49 to 862 MHz. In cases in which direct frequencies in the range of 49 to 862 MHz are used, there is no need for a BDCC. However an LNA (Low Noise Amplifier) can be used if the antenna is remotely mounted to overcome cable losses. Figure 6 shows a typical BDCC card.



RF Input
SMA Connector

IF Output
F Type connector

Figure 6 BDCC Card

The antenna is attached to the RF input of the BDC. The IF Output (BDC) is fed to the IF input of the Tuner/Demod card.

Figure 7 shows a typical Tuner/Demod, BDC, and antenna connection.

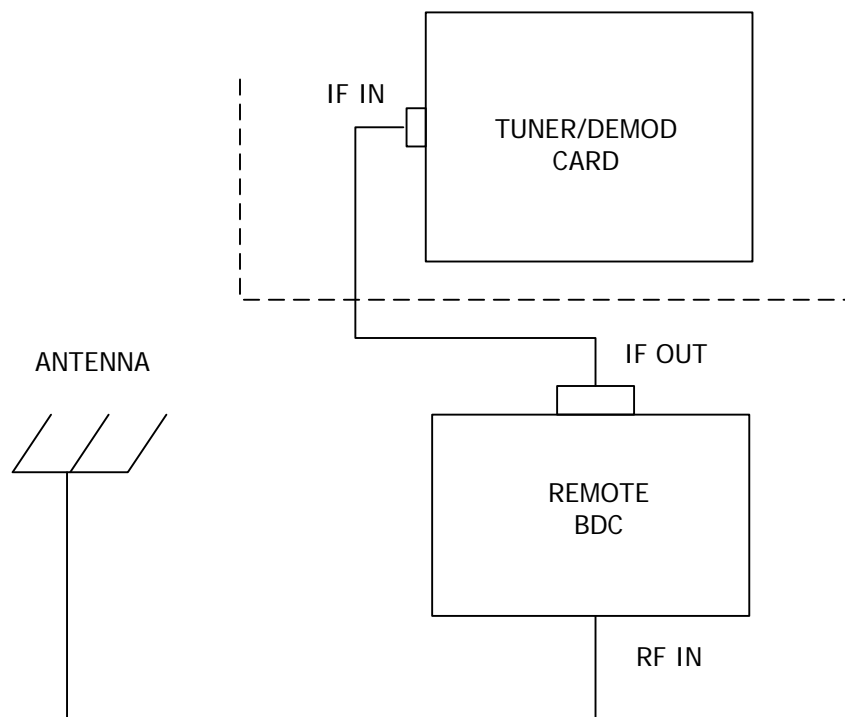
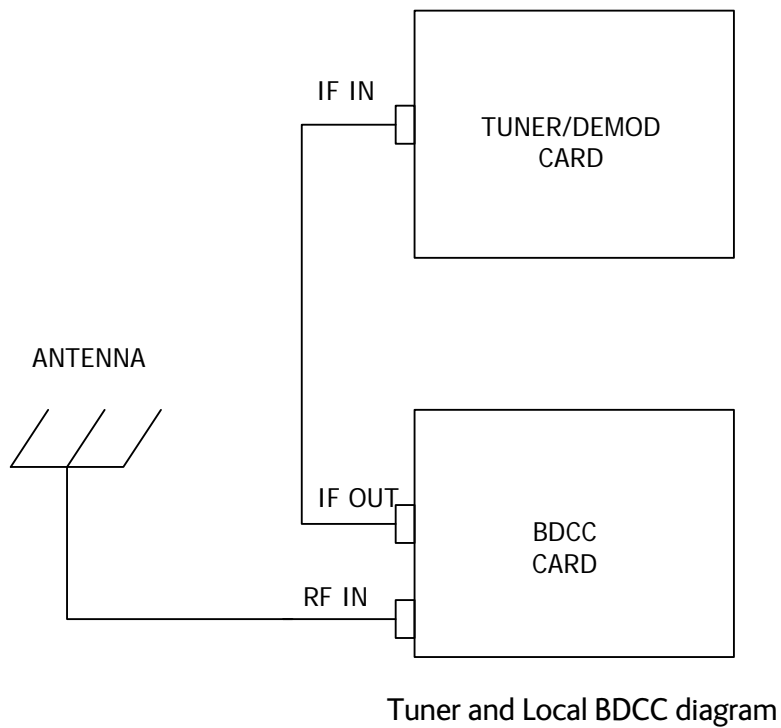


Figure 7 Tuner/Demod and BDC diagrams

Power Switch

Active LED Locked LED

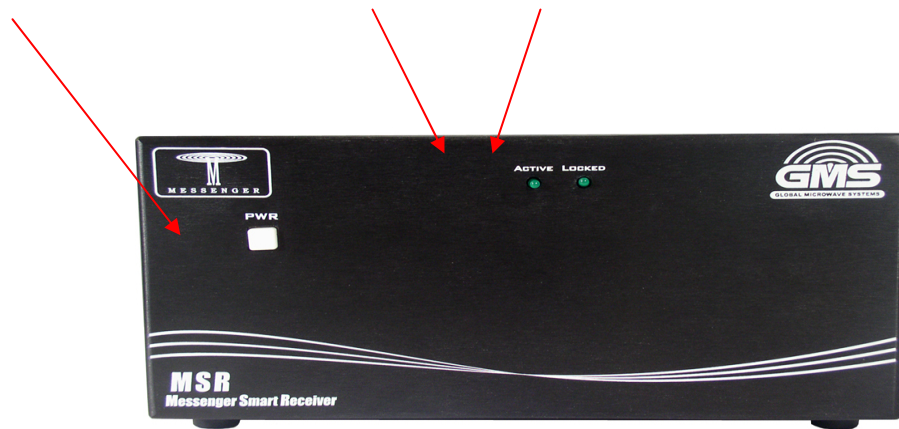


Figure 8A Front Panel

CTRL Key



Display

Arrow keys

ENTR Key

Figure 8B Front Panel w/Optional Control Panel

4.2.1 Power Switch

Depressing the Power On toggle switch will cause system power (12 VDC nominal) to be applied to the MSR unit. Depressing the switch again will cause system power to be removed.

4.2.2 Active LED

The Active LED indicates that the system has power.

4.2.3 Locked LED

The Locked LED indicates that at least one of the Demodulators is locked and outputting an MPEG TS if it is available. Note: A lit; Locked LED indicator does not guarantee that the TS is completely error free. A blinking LED indicates a non-locked condition.

4.2.4 Control Panel (Optional)

4.2.4.1 Display (Alpha-Numeric)

The display gives the user a visual indication of the reception status and allows the user to enter data for key parameters.

4.2.4.2 Arrow Keys (Up/Down)

The up/down arrow keys are used to increment (up) or decrement (down) data entry values to be entered for a specific parameter.

4.2.4.3 CTRL key

The CTRL key allows the user to scroll thru the various modes of operation.

4.2.4.4 ENTR Key

The ENTR key is used to enter data for a specific parameter.

4.3 MSR Rear Panel

Located on the rear panel, are the following interface connectors: a “SPI Out” connector, a “Diversity In” connector, a “USB-1” connector, a “RS232C” connector, two “ASI” connectors, and a “Power” connector. See Figure 9.



Figure 9 Rear Panel

4.3.1 RS-232C and USB-1 Port

Full MSR System control and status is accessed through either the RS-232C or USB-1 control ports via the MS Windows based control application. The RS-232C uses a DB9-F connector. The USB-1 uses a USB-B connector. Table 1 shows the RS-232C

Connections. Table 2 shows the USB-1 connections. **Note: If an optional control panel is used on the MSR, the RS232 port is not available.**

Pin	Signal	Description
2	Tx	Transmit
3	Rx	Receive
5	Gnd	GND Connection

Table 1

Pin	Signal	Description
1	5V	5V POWER
2	USBDM	D -
3	USBDP	D +
4	USB GND	GND

Table 2

4.3.2 DVB ASI Out (Asynchronous Serial Interface)

The DVB MPEG transport stream in high-speed serial format is output on this port via a BNC-F connector. The DVB ASI transport stream conforms to ETSI Spec TR101891 V1.1.1 (2001 – 2002).

4.3.3 DVB SPI Parallel Interface (Synchronous Parallel Interface)

The DVB MPEG transport stream is output as parallel data at this port. The connector used is a 34 Pin Micro-Header, ASP-114859-01, Samtec. The DVB SPI transport stream conforms to the DVB-SPI as defined in EN 50083-9 (ISO/IEC 13818-1 compliant) interface with LVDS differential outputs. See Table 3 for pin assignments.

PIN	SIGNAL	PIN	SGNAL
1	MP DATA0+	18	CLKOUT -
2	MP DATA0-	19	GND
3	MP DATA1+	20	I2C0
4	MP DATA1-	21	I2C1
5	MP DATA2+	22	DEV4
6	MP DATA2-	23	GND
7	MP DATA3+	24	DIF LIN 1
8	MP DATA3-	25	MP DATA5+
9	MP DATA4+	26	MP DATA5-
10	MP DATA4-	27	MP DATA6+
11	MP CLK+	28	MP DATA6-
12	MP CLK-	29	MP DATA7+
13	MP FRM+	30	MP DATA7-
14	MP FRM-	31	MP LOCK+
15	MP STR+	32	MP LOCK-
16	MP STR-	33	MP FAIL+
17	CLKOUT+	34	MP FAIL-

Table 3

4.3.4 DC Power

A 2-pin connector is used to provide an interface for the DC power input. The pin assignments for this connector are shown in Table 4. For further equipment protection, reverse polarity circuitry has been implemented internal to the MSR. The MSR can draw approximately 5.75 Amps max if fully loaded and driving eight BDCs.

Pin	Signal	Description
1	POWER 9-15VDC	Nominal +12VDC, 1 to 5.75 amp draw max
2	GND	GND Connection

Table 4

5 Software Overview

Configuration, control and monitoring of the MSR unit can be implemented by using the Windows based control program. This program provides control of the center frequency, COFDM bandwidth, power for remote BDCs and the acquisition mode of the system. All other modulation parameters are automatically detected and set during the acquisition process. Once locked onto the signal, the MSR Control software provides an extensive array of status information as shown in Figure 10.

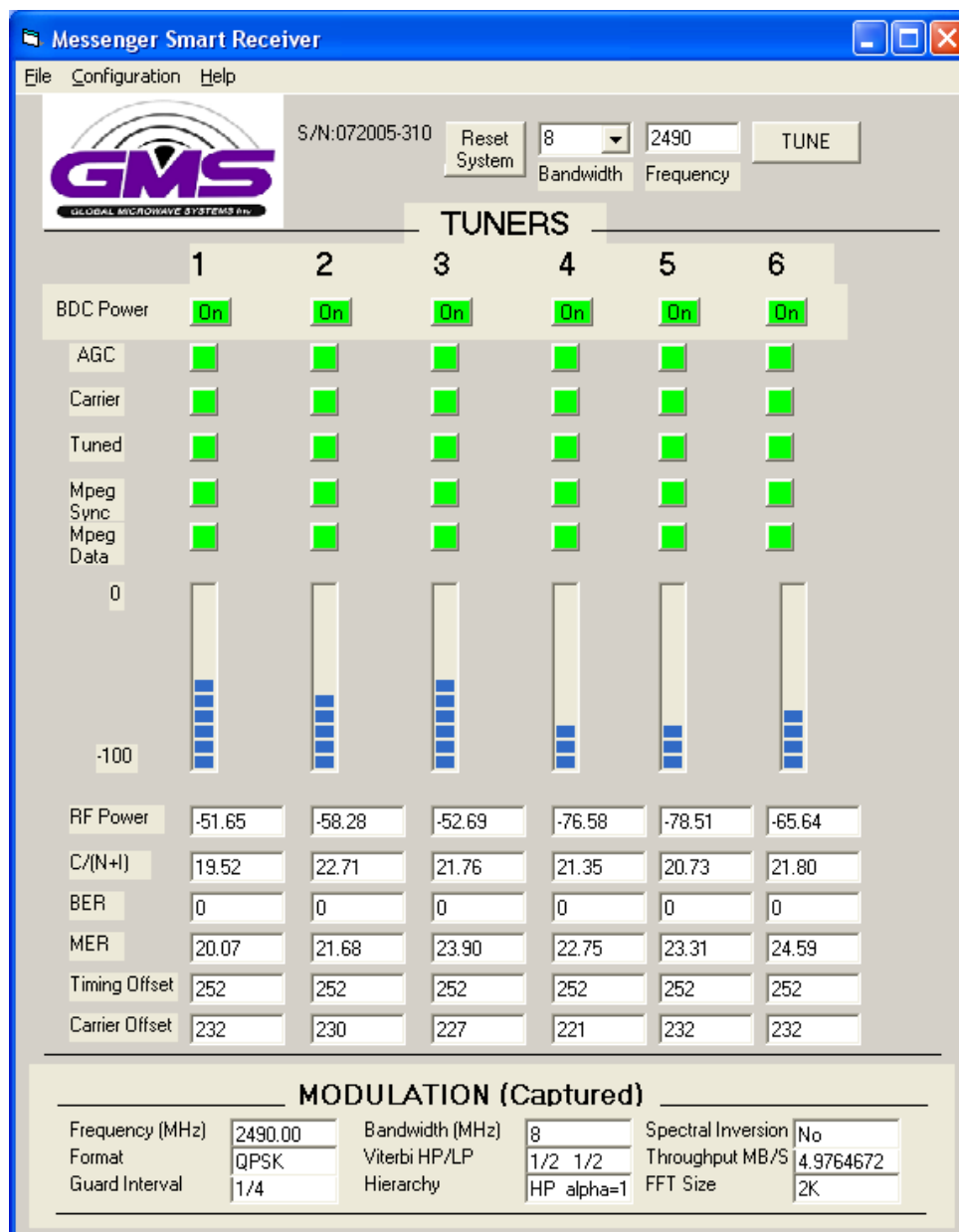


Figure 10 User Interface (Maximum info display)

Note: The display can be adjusted from a very simple screen up to the most complex Screen as shown in Figure 10 (See section 6.3.2.2)

5.1 System Requirements

The MSR Control program has been developed and tested on Microsoft Windows 2000 and Windows XP.

5.2 Software Installation

The following instructions outline the installation process for MSR Control program:

Insert provided CD-ROM into computer CD reader.

Run 'setup.exe' file. This will launch the GMS_MSR setup program and several initial setup files will begin to be copied into the computer.

After the initial setup files are copied, the GMS_MSR setup program will prompt the user to close any applications that are running. Once all other programs are exited, click on the 'OK' button.

The GMS_MSR setup program will prompt the user to click on the 'computer icon' button to begin installation. If desired, the user can change the destination directory from the default. Click on the 'computer icon' button.

The GMS_MSR setup program will then prompt the user to 'Choose Program Group'. If desired, the user can change the program group from the default. Click on the 'Continue' button.

After installing the MSR program, the setup program will display a window indicating the setup was completed successfully. Click 'OK'.

To load USB Drivers see "Loading USB Drivers for MSR" on CD-ROM.

5.3 Software Functions

The MSR control software provides the user access to many different configuration, control and monitoring options. When the program is launched, the screen shown in Figure 11 is displayed. The user should first select the serial port the computer is connected to via the Serial Port Selector and Status region. If the selected serial port is valid, the gray-colored status box will show 'Ready'. The Device Selector region allows the end user to select the MSR unit.

To configure the MSR, select the 'MSR' box in the Device Selector region. Once the 'MSR' box is selected the screen shown in Figure 8 is displayed. The MSR Control program contains function buttons and all the configurable settings available on a MSR. The following sections explain the various functions.

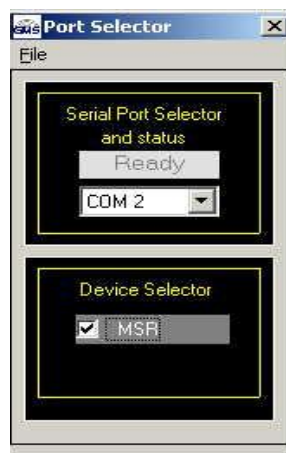


Figure 11 MDL Configurator

5.3.1 Function Buttons and Selects

Reset System Button: Clicking on this button re-initializes all tuners to a known state.

Bandwidth Select Option: The system bandwidth can be selected in this field. The selections are 6,7 or 8 MHz bandwidth.

Frequency Option: The system receive frequency is set in this field. The units are displayed in MHz. Tuning resolution is 10 KHz per step.

Tune Button: Clicking on this button initiates the acquisition process. In this mode all modulation parameters are automatically detected and set during this process. The parameters which are captured are displayed in the “Modulation (Captured) region.

5.3.2 Pull-Down Menu Definitions

There are pull-down menus that are included in the MSR Control program. The following section describes these menus in detail. Refer to Figure 12.

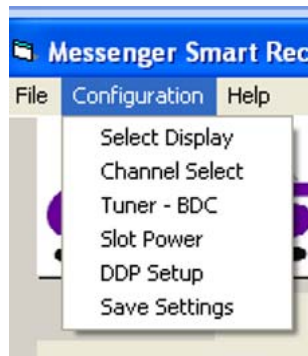


Figure 12 Configuration Menu

5.3.2.1 File

This pull-down menu is used solely to exit the MSR Control program. Alternatively, the 'X' box in the upper right hand corner of the window can be used to exit the program.

5.3.2.2 Configuration

This pull-down menu contains five configuration options as outlined below:

Select Display: This selection allows the user to configure the main display (See Figure 13). By applying a check to the desired feature the main display will show the selection. For example, if the user wants to only display the “C/N” and the “BER” then the “C/N Indicator” and the “BER Indicator” would be checked. See Figure 14.

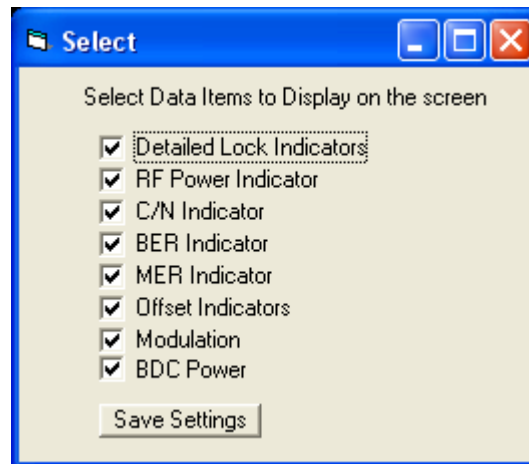


Figure 13 Display Selection

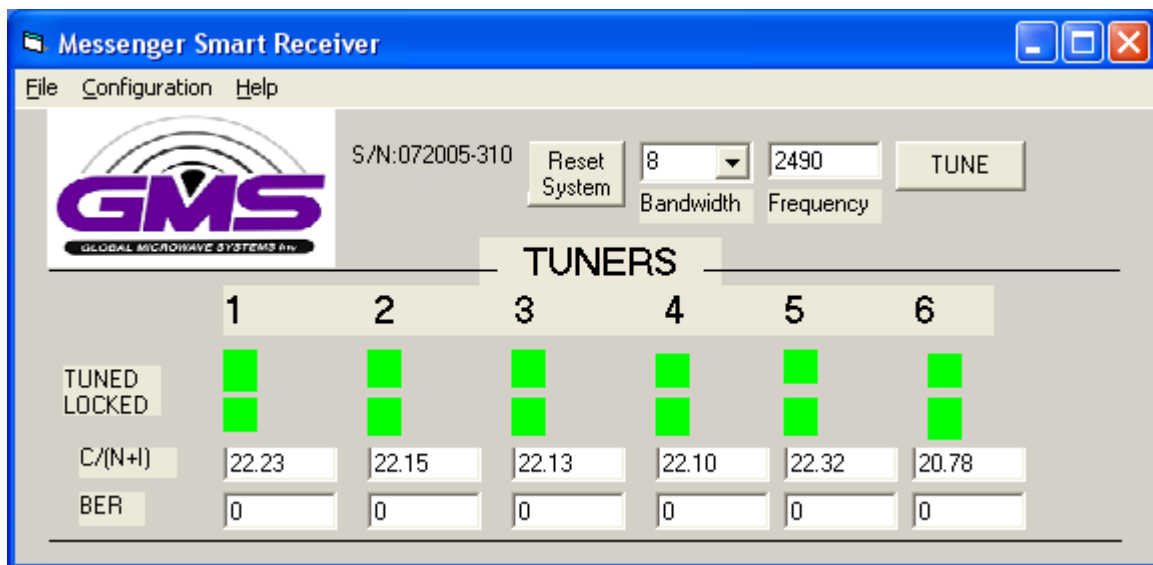


Figure 14 Display with C/N and BER enabled

Channel Select: This selection allows the user to choose the desired frequency input method. There are four basic methods: Manual, BAS New ,BAS Old, and “User Defined”. The selection pulls up a menu as shown in figure 15A.

Using the manual method, the user can enter the desired center frequency manually at the main screen. Using the BAS method, pre-determined frequencies as established by the Federal Communication Commission, for the broadcast auxiliary services band, are used for the center frequency input. Using the “User Defined” method, user-defined frequencies are used for center frequency input.

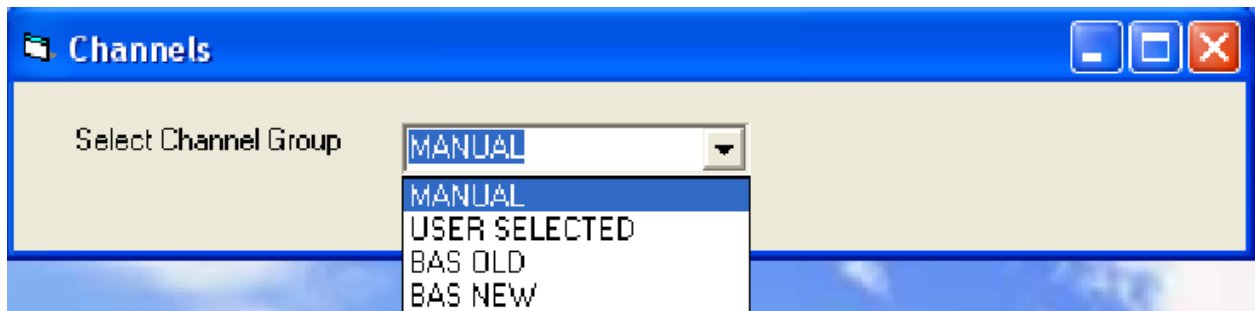


Figure 15A Channel select method

If “Manual” is selected from the “Channels” pull down menu, the main screen as shown in figure 10 will be displayed

The “User Selected” selection from the “Channels” menu, displays a screen which allows the user to input user defined frequencies (see figure 15C). Up to 30 different frequencies can be stored. When defined frequencies have been entered, click the “Save Changes” button to store settings. Figure 15D shows the main screen when the “User Selected” method is used. The pull down menu (User Channels) on the main screen is used to select the desired frequency. After the selection is made then the system can be tuned to the selected frequency by clicking on the “Tune” button of the main screen.

Figure 15B shows the main screen when the “BAS Old” or “BAS New” is selected from the “Channels” menu. The pull down menu (BAS new/old Channels) on the main screen is used to select the desired frequency. After the selection is made then the system can be tuned to the selected frequency by clicking on the “Tune” button of the main screen. The “BAS New” selection is the latest defined frequencies as established by the Federal Communications Commission

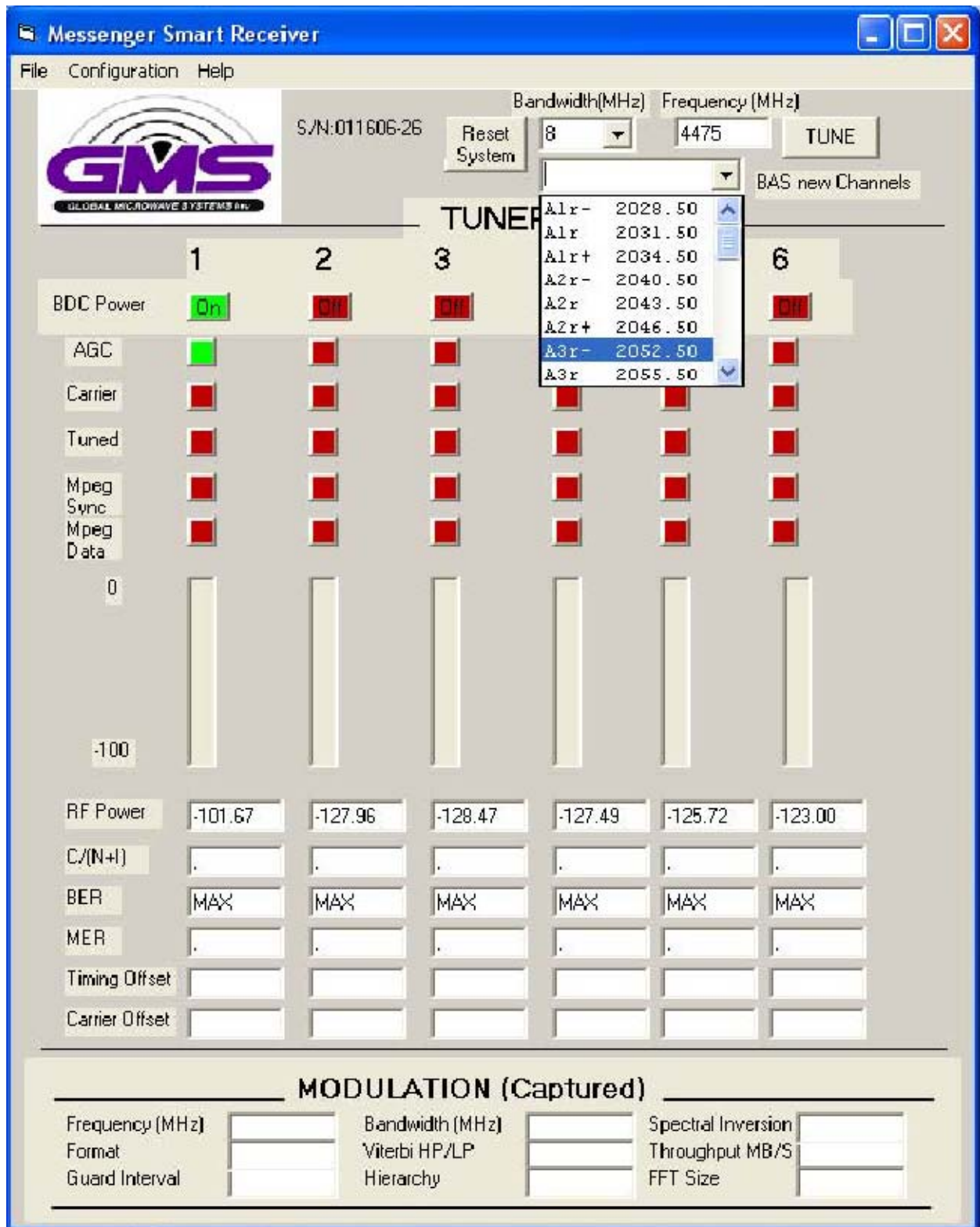


Figure 15B BAS Frequency select method

Channels

Select Channel Group

USER SELECTED

USER SELECTED CHANNELS

NAME	FREQUENCY	NAME	FREQUENCY	NAME	FREQUENCY
1	4575	11	0	21	0
2	4200	12	0	22	0
3	4475	13	0	23	0
4	0	14	0	24	0
5	0	15	0	25	0
6	0	16	0	26	0
7	0	17	0	27	0
8	0	18	0	28	0
9	0	19	0	29	0
10	0	20	0	30	0

SAVE CHANGES

Figure 15C User defined selection table

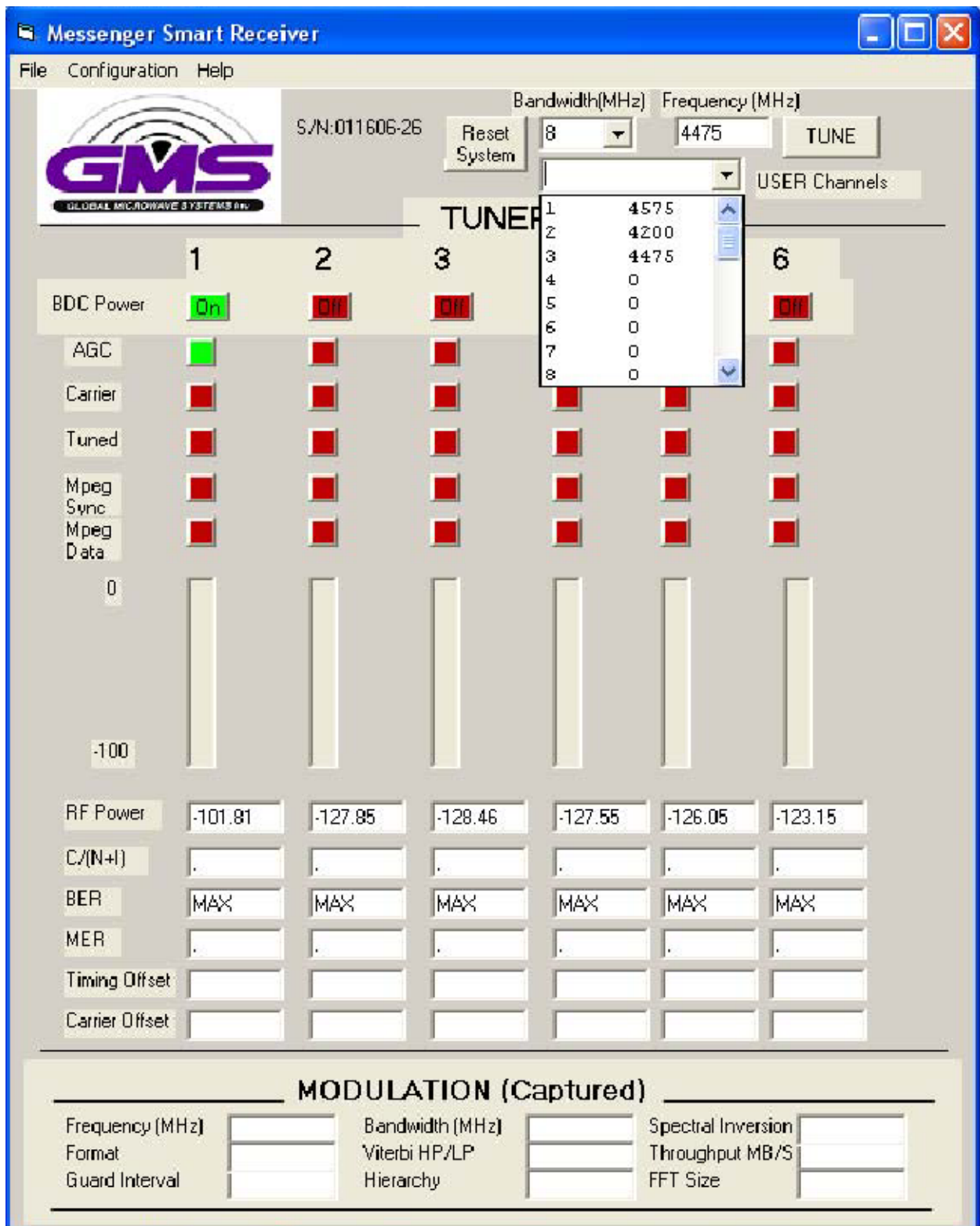


Figure 15D User Defined select method

Tuner-BDC: This selection pulls up a password window as shown in Figure 16. Upon initial installation of the MSR unit, the user will be asked to enter a password twice. This is now the password for the system. The user has the ability to change the password as discussed later in this section. After the correct password is entered a window as shown in Figure 17A or 17B is pulled up. Each slot of the MSR, except slot number one, can be configured to accept a Tuner/Demod card or a BDCC card (Local block down converter). Slot number one must be a Tuner/Demod card. The Tuner/Demod card can accept IF input from a Remote BDC or Local BDCC. The “Tuner Configuration” menu allows the user to setup various parameters based on system requirements.



Figure 16 Password

The MSR (and many other digital receivers) are capable of receiving direct frequencies in the range of approximately 49MHz to 861MHz. If the transmitter is not in this range, then a down-converter (BDC/BDCC) is used to convert the frequency to this range. The frequency out of the down-converter is called the IF (intermediate frequency) which is fed to a Tuner/Demod card installed in a MSR.

Down-converters have an LO (local oscillator) which is mixed with the DBV-T transmitter frequency and converts it to the IF frequency. The MSR locks on to the IF frequency. The MSR must know the LO of the BDC and the frequency of the DVB-T transmitter to calculate for the correct IF frequency to tune to. This is the value that must be entered in the “Set BDC LO Frequency” field. (See Figures 17A & 17B).

The following equation will determine the IF frequency:

$$\text{“Transmitter frequency - LO = IF frequency”}.$$

For example, if the transmitter is set for 2000 MHz and the LO of the down-converter is 2800 MHz, then the difference (IF frequency) is 800 MHz. Each time the transmitter frequency is changed, the MSR must be re-tuned to make corrections for the correct IF frequency. It should be noted that the equation can produce negative or positive answers. The negative answer may indicate the receiver wants the signal to be inverted. See section 6.3.3.2 of the MDT-B user manual (100-M0056) for inverting the signal. Reference the GMS web site for BDC details under “RF modules/blockdown converters” at <http://www.cobham.com/gms>

Remote BDC Configuration Window (See Figure 17A)

(The “BDC Type” must be set to “remote” in this mode)

“Select Tuner”: Each tuner used in the MSR system must be configured. The “Tuner Select” is used to choose the tuner to be configured. This pull down menu has a selection from 1 thru 6 corresponding to tuner cards.

“Set BDC LO”: The LO frequency of the BDC is entered in this field. The units are in MHz. All BDC-s have 1 MHz steps for LO frequency, except BDCF-s (0.01 MHz steps).

“Tuner Slot Location”: Slot number one of the MSR is always configured with a Tuner/Demod card provided that the housing is being used for reception (Note: The MSR housing can be used as a housing for tuner/demods that are connected to a second housing that is performing the reception. In this case slot one can be used). Therefore, normally “Tuner Slot Location” will be set to “1” from the pull down selection. If, for example, physical slot number two is configured with a BDCC card installed then the next available slot for a tuner would be number three. In this case Tuner/Demod card number two would be configured for “Tuner slot location” number “3”. In effect a BDCC card eliminates a physical MSR slot.

“Gain from Ant to Tuner”: Allows the user to specify the gain from the BDC input to the MSR input. If a long cable is used to connect the BDC to the MSR or a power splitter is used, the overall gain will be reduced. A typical BDC has a gain of 30 dBm. If the cable loss at the operating frequency was 5dB, for example, then the effective BDC Gain would be 25 dBm.

“BDC Type”: The type is selected from this pull down menu. The choices are “None”, “Local” and “Remote”. If a BDCC is installed in a specified slot then the selection would be “None”.

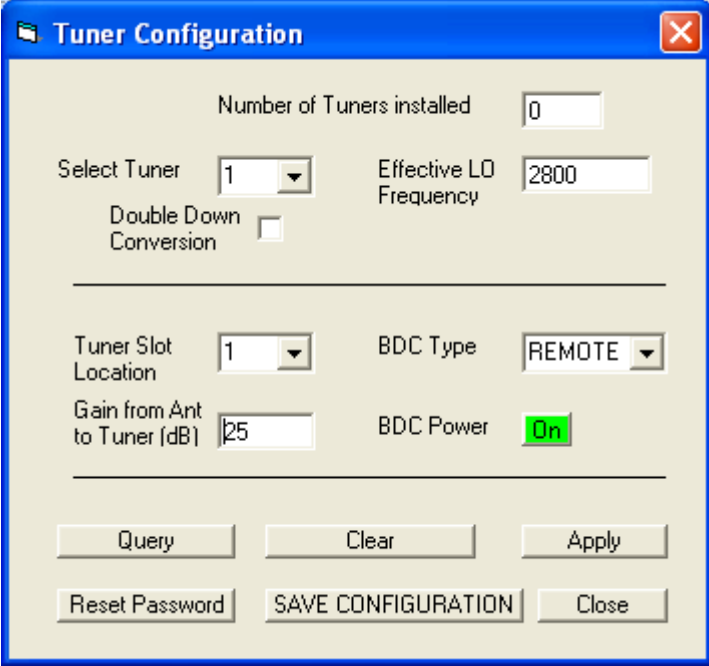
“BDC Power”: Remote BDCs can be powered locally or remotely. Remote power is provided from the MSR through the F connector of the Tuner/Demod card. Clicking the “BDC Power button” to “On” will supply +12 VDC through the coax cable to the BDC. Power can be turned on or off independently for each channel.

If the BDC is located relatively close to the MSR unit then using remote power makes sense. However, if the BDC is located at a great distance away from the MSR, there may be excessive DC drop in the

coax cable (due to cable resistance). If this is the case, then local DC power should be considered. If unsure of the DC voltage drop, then measure the DC voltage present (using a DMM) at the end of the coax cable run. The DC normal operating voltage is approximately +12 VDC but can operate down to +10 VDC.

Local power is provided by applying +12 VDC to pin 1, GND to pin 3 of the DB-9 connector located on the bottom of the BDC. The +12 Volt power must be able to source at least 500ma. The power switch (located on the side of the BDC) enables the user to control the 'ON'/'OFF' positions for local power.

NOTE: If using local power, the remote power should be turned 'OFF' using the BDC Power On/Off button. Not doing so could cause damage to the tuner



The image shows a software window titled "Tuner Configuration" with a blue title bar and a red close button. The window contains several configuration fields and buttons. At the top, "Number of Tuners installed" is set to 0. Below this, "Select Tuner" is a dropdown menu showing 1, and "Effective LO Frequency" is a text box showing 2800. There is a "Double Down Conversion" checkbox which is unchecked. A horizontal line separates the top section from the bottom section. In the bottom section, "Tuner Slot Location" is a dropdown menu showing 1, and "BDC Type" is a dropdown menu showing REMOTE. "Gain from Ant to Tuner (dB)" is a text box showing 25, and "BDC Power" is a green button labeled "On". At the bottom of the window, there are six buttons: "Query", "Clear", "Apply", "Reset Password", "SAVE CONFIGURATION", and "Close".

Figure 17A Remote BDC Setup

Local BDCC Configuration Window (See Figure 17B)

(The "BDC Type" must be set to "Local" in this mode)

The following functions have been previously defined in the Remote BDC section: "Select Tuner", "Set BDC LO", "Tuner slot location", "BDC Type", "Gain from Ant to Tuner" and "BDC Power".

Note: BDCC cards are powered remotely only (From MSR)

“BDCC Address”: Each locally mounted BDCC is assigned a unique address. If a tuner is to operate with a specific BDCC then the tuner must be set to match the address of the BDCC. The address will be labeled on the BDCC chassis.

“IF Attenuation”: A BDCC has a typical maximum gain of 39 dBm. The gain of the BDCC can be attenuated with this setting. The value can be changed in increments of 1dB. BDCCs are typically shipped with the gain adjusted to 30 dBm (+/- 2 dBm) with an IF attenuation set between 9 and 11 dBm. This attenuation can be reduced if you need to drive long cable runs.

“RF AGC Mode”: The two selections from this pull down menu are “Auto” and “Manual”. In normal operation the AGC (Automatic Gain Control) is set to “Auto”. In the “Auto” mode, RF attenuation is automatically adjusted based on the strength of the RF Input signal or signals going in to the BDCC. By selecting the “Manual” mode, the “Auto” mode is disabled and the RF gain of the BDCC is fixed at approximately 20 dBm.

NOTE: Caution must be taken when operating in the “Auto mode”. If multiple Transmitters are operating within the band of the system and an unwanted frequency has a higher power at the antenna than the tuned frequency, then the overall performance of the BDCC could be affected. The unwanted frequency could cause the AGC to decrease the gain of the BDCC thereby decreasing the signal to noise ratio and increasing the noise figure. If the desired transmitter is a long distance away from the receiver antenna, reception problems may occur. If this condition should occur the “Manual mode” would be recommended.

“RF Attenuation”: This display allows the user to monitor the level of the RF attenuation of the BDCC. This function is available when the BDCC RF AGC mode is in “Auto”. If in the “Manual mode” the RF attenuation will always be zero.

“LO Frequency”: The LO frequency of the BDCC is displayed in this field.

“Poll On”: This selection provides the user with the status of the RF attenuation level (dB). This is typically used or turned on when the BDCC is switched to “Auto” RF attenuation mode. . This setting defaults to “Poll ON” when in the “Auto” mode and “Poll Off” when “Manual” mode is selected. The “Poll On/Off” can be toggled on or off manually.

Tuner Configuration

Select Tuner: 2 Set BDC LO Frequency: 2800

Tuner Slot Location: 2 BDC Type: LOCAL

Gain from Ant to Tuner (dB): 25 BDC Power: **On**

BDCC Address: 208

IF Attenuation (dB): 5

RF AGC Mode: Auto

RF Attenuation (dB): 0 Poll ON

LO Frequency (MHz): 0

Query Apply Close

Reset Password SAVE CONFIGURATION

Figure 17B Local BDCC Setup

“Query”: This selection is used to query the system for the latest settings for the selected tuner.

“Apply Button”: This selection is used to apply all changeable parameters of the system.

“Close”: Exit the tuner configuration

“Reset Password”: This selection allows the user to change the password. The user will be asked to enter the new password twice to confirm input. The password is case sensitive. After clicking this button the user will be asked to re-enter a new password upon re-entry to the Tuner-BDC configuration

“Save Configuration”: Once the previous steps have been completed, “Save Configuration” to ensure all selections have been properly saved.

Slot Power

Remote or local BDCs/BDCCs are normally powered thru a Tuner/Demod card. Remote power is provided from the MSR through the “F” connector of the Tuner/Demod card. Clicking one of the “Slot Power” buttons to “On” will supply +12VDC through the coax cable to the BDC/BDCC. See Figure 18. Position “1” corresponds to Tuner/Demod card 1, position “2” corresponds to Tuner/Demod card “2”, etc. If a BDCC is configured to reside in one of the slots then it would be invalid to turn on the “Slot Power” in which the BDCC resides.

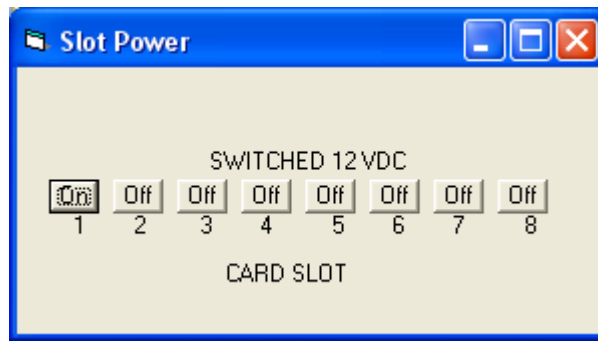


Figure 18 Slot Power

DDP Set up

This selection opens up a window where user can control various features, depending on the system configuration.

If the system has Encryption, High Speed Data and User Data capabilities, then the window will look like one in Figure 19.

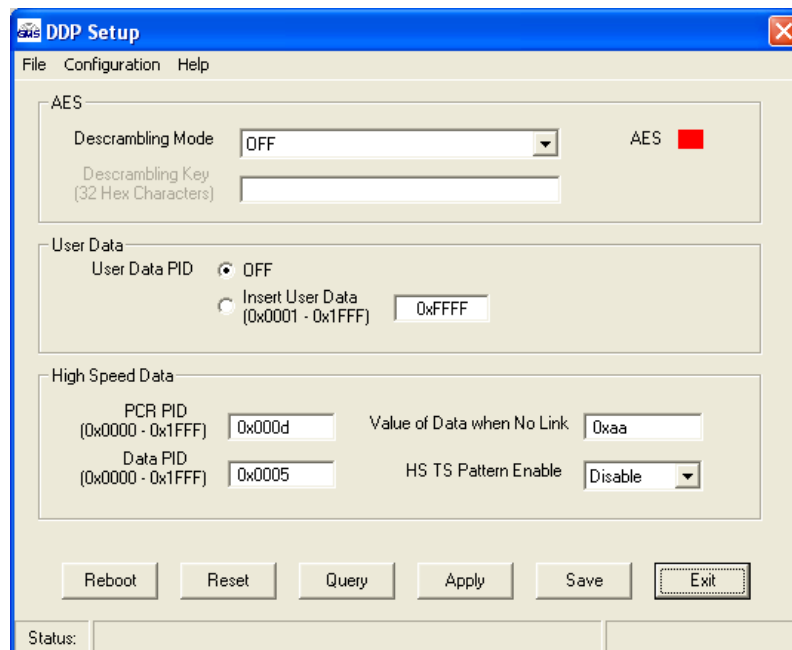


Figure 19, DDP Set up Window

- *AES, NEVER Store the key in the DDP mode*: This mode does AES Decryption but the Decryption key must be reloaded every time it is powered off. This is for higher security.
- *AES, Store the key in DDP mode*: This mode does AES Decryption and the DDPC remembers the Decryption key so when the DDPC is powered on it will come up working.
- *Descrambling key*: This box loads the decryption key. The *Descrambling mode* must be set to an AES mode before this input is available.
- *User Data* enables User Data capabilities.
- *High Speed Data* enables MSR to receive High Speed Data.

“Reset”: Clicking on this button re-initializes the DDPC to a known state.

“Query”: Clicking on this button will set all the fields to the current operation mode, except the Descrambling Key. This selection is used to query the system for the latest settings.

“Apply”: This selection is used to apply all changeable parameters of the system.

“Save”: Saves the current settings to the DDPC so when power is recycled the DDPC will remember the last settings.

“Exit”: Exit the DDP configuration

5.3.2.3 Help

This pull-down menu contains information about the MSR Control software. The information is outlined as below:

About: This selection pulls up a window that displays the Version number of the GMS MSR Control program, as well as FW and HW versions, model and serial number of MSR.

5.3.3 Field Definitions

There are several different fields used for monitoring by the MSR Control program. These fields are broken out by regions on the main MSR Control screen. The following sections address the regions and their associated fields.

5.3.3.1 “Modulation (Captured)” region

Frequency (MHz): RF input frequency at the BDC input.

Format: COFDM modulation type. The modulation types are QPSK, 16 QAM, or 64 QAM.

Guard Interval: Modulation guard interval size. The following values can be selected: 1/32, 1/16, 1/8, or 1/4.

Bandwidth: COFDM bandwidth. The following values can be selected: 6, 7 or 8 MHz.

Viterbi HP/LP: Forward Error Correction

Hierarchy: XXX

Spectral Inversion: OFDM polarity status. Values can be yes (inversion) or no (no inversion).

Throughput MB/S: Channel data rate

FFT Size: Number of carriers. 2 K or 8 K.

5.3.3.2 “Tuners” region

This region displays the status of several important parameters. The MSR system can be configured with up to 6 tuners. So there are 6 columns of status information to correspond to the 6 possible tuners.

AGC: The tuners Automatic Gain Control is locked and tracking the input signal. A periodic on/off of this signal is normal.

Carrier: A COFDM Carrier has been detected and locked at the selected tuning frequency.

Tuned: The carrier is being demodulated because the symbol-tracking loop has locked.

Mpeg Sync: The SPI Transport stream sync signal is active.

Mpeg Data: The SPI Transport stream is locked

RF Power: This field represents the RF power at the input of the tuner/demod module. *Value expressed in dBm.*

C/(N + I): This is the ratio of carrier level and noise + interference (in dB).

BER: Bit Error Rate. This field conveys the BER of the received signal. The BER is a Pre FEC error correction.

MER: Modulation Error Ratio. This field conveys the MER of the received signal as measured by the demodulator. *Value expressed in dB.*

Timing Offset: This is the Offset from the expected timing due to Doppler or variations in incoming data stability (in PPM).

Carrier Offset: This is the offset between the detected carrier frequency and the MSR's internal frequency standard (in KHz).

5.4 Control Panel (Optional)

The control panel allows the user to monitor RF input and change key parameters such as Frequency, bandwidth, the channel plan, or BDC power settings. The operational program flow chart is shown in Figure 19A. Note that Front Panel is operational only if the GUI isn't open.

Figure 19B shows a typical main display screen. The display shows the status of the selected RF input, the Signal to Noise ratio (CNR), and the Lock status (LOCK). The LOCK indicator is displayed when the system is in the RF lock condition. Depressing the arrow key (up or down) will temporarily (5 seconds) display the MPEG2 packet errors in place of the CNR. Under normal conditions the packet errors should be 0 to 1. Packet errors are accumulated in a packet error counter. The packet error counter is reset based on the “PKT Err Timeout” value in seconds. The default time is 10 seconds. The value can be changed on the control panel using the arrow (up/down) key. The screen used to make the “PKT Err Timeout” change is made available to the user when exiting the “Setup mode”.

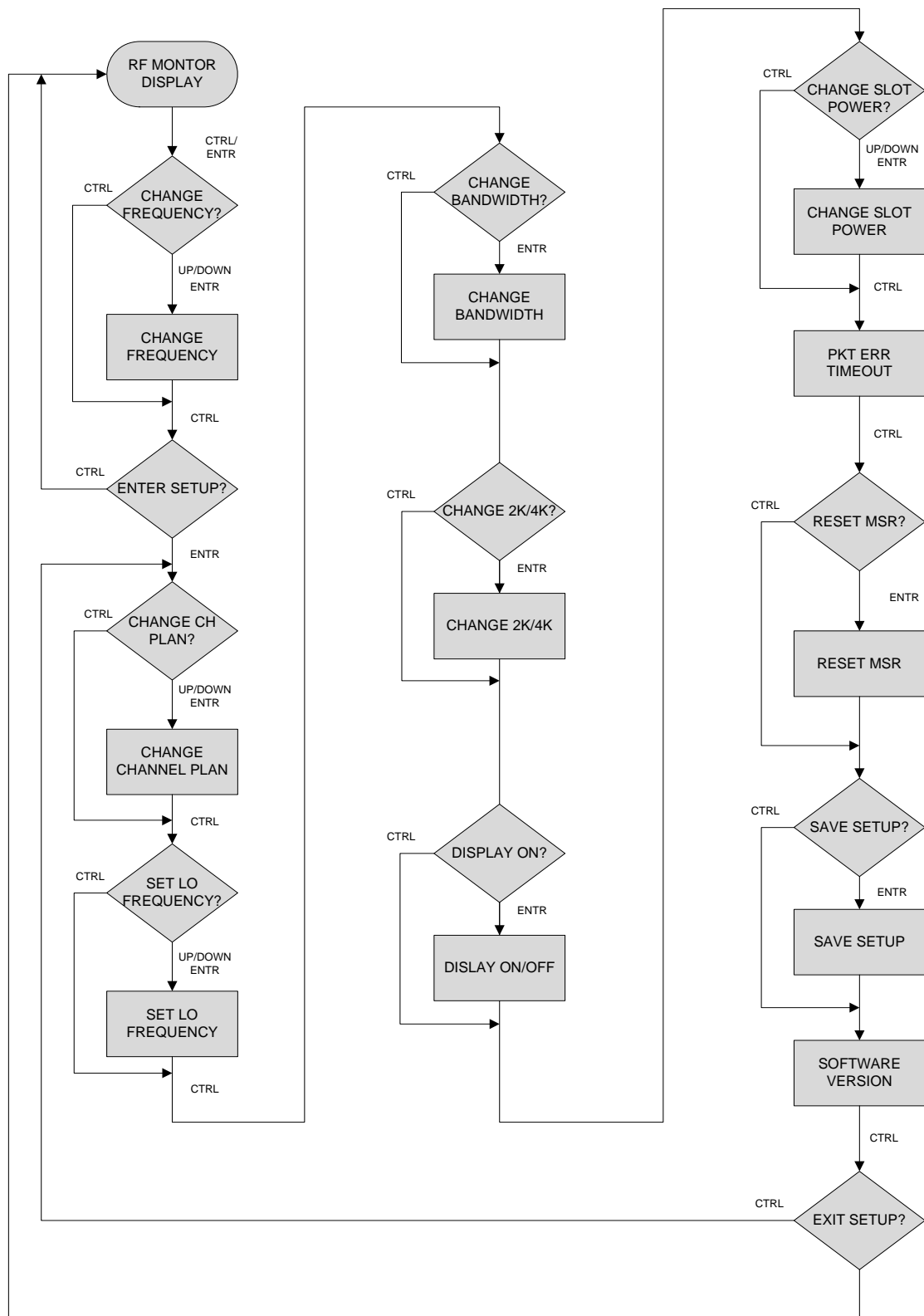


Figure 19A The operational Program Flowchart

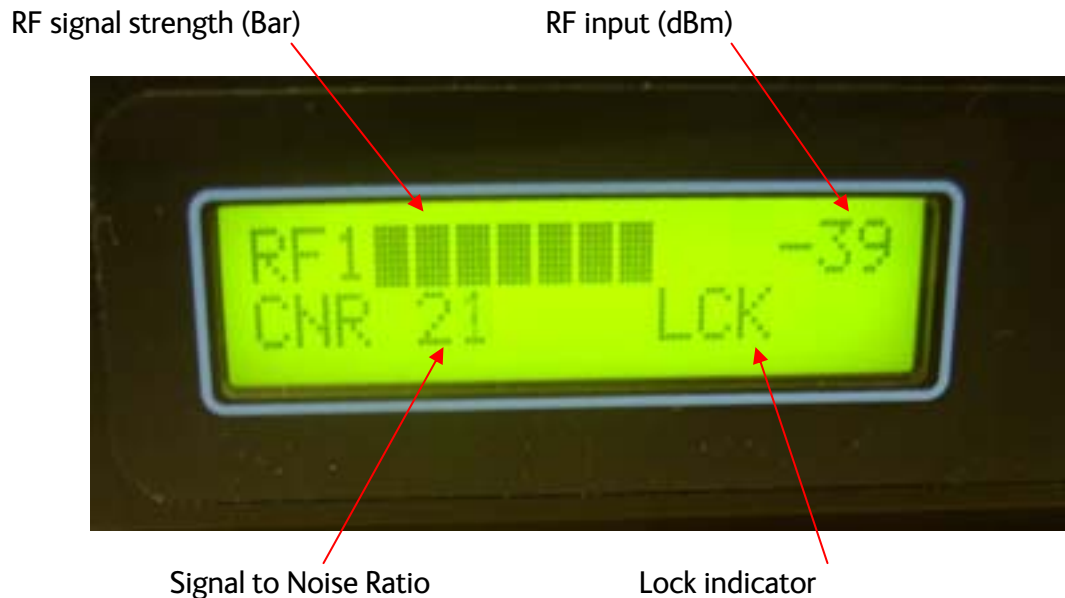


Figure 19B Main Display

5.4.1 Change frequency mode

The MSRs frequency can be changed to match the incoming COFDM modulated signal in this mode. From the main display depress the CTRL or the ENTR key (See Figure 19). Use the up or down arrows to increment or decrement to the desired frequency. Once the desired frequency has been achieved release the up/down button. Depressing the ENTR key will select the desired frequency. To save the frequency setting, depress the CTRL key and enter the “Detailed setup” by depressing the ENTR key. Scroll thru the menu by depressing the CTRL key until the message appears which says “SAVE Setup”. Depress the ENT key to save the settings (see figure 19C).



Figure 19C Save/Exit Select

5.4.2 Change Channel Plan mode

There are four different channel plan selections in this mode. They are Manual, BAS new, and BAS old, User defined. If “Manual” is selected, the increment amount will be 0.25 MHz steps in the “Change Frequency mode”. If the “BAS” new or old is selected, the increment amount in the “Change Frequency mode” will be pre-determined as established by the Federal Communication Commission. If the “User defined” is selected, the increment will be as specified by the user.

To make a channel plan selection, enter the “Detailed setup”. Use the arrow key (up or down) to scroll thru the selections. Use the “ENTR” key to make a selection. Depress the ENT key in “Save Setup” to save the settings.

5.4.3 Change Bandwidth mode

The MSRs bandwidth can be changed to match the incoming COFDM modulated signal. From the main display Depress the CTRL button twice. Enter the detailed setup mode by depressing the “ENTR” key. Depress the “CTRL” key. Use the up or down arrow to increment or decrement to the desired bandwidth. Depress the “ENTR” key to select the desired bandwidth. Depress the ENT key in “Save Setup” to save the settings

5.4.4 BDCC Power settings mode

As described I section 6.3.2.2 remote BDCs can be powered locally or remotely. Remote power is provided from the MSR through the F connector of the Tuner/Demod card. In this mode each individual channel can be configured to supply 12 VDC power to a remote BDC/BDCC or not.

To set the BDC power (on or off), enter the Detailed Setup . Depress the CTRL Button twice. The screen which allows the setting of BDC power for each channel is displayed (see Figure 20). The top row indicates the slot position. The second row indicates if power is on (y) or power off (n). Use the arrow key to scroll forward (up) or backwards (down) thru the channels. Use the “ENTR” key to toggle (On or Off) the power for the selected channel. The CTRL key is used to exit this mode. Depress the ENT key in “Save Setup” to save the settings



Figure 20 BDC Power Control Display

6 Specifications

The following sections outline the overall specifications for the MSR unit.

Main Chassis

Card Slots Per Chassis

Number of Slots: 8

Number of Tuner/Demod Cards: Up to 6 (Slot 1 must contain a Tuner/Demod Card)

Slots 2-8 can be any combination of Tuner/Demod Cards and/or Block Down-Converter Cards

Interfaces

Control

RS-232C via DB9-F Connector

USB-1 via USB-B Connector

Transport Stream Out

ASI (2 CH) via BNC-F Connector

SPI via 34 Pin Micro-Header, SAMTEC, ASP-114859-01 Connector

MSR Serial Chaining Interfaces (For Special Applications)

SPI/Diversity Out (Same port as Transport Stream Out, SPI Interface)

Diversity In via 34 Pin Micro-Header, SAMTEC, ASP-114859-01 Connector

DC Power

2 pin, AMP 350786-2 Connector

AC Power (Optional with external in-line cable assembly)

Controls & Status

Main Power: Front-Panel On/Off Control

BDC Power: Independent On/Off control via Windows Control SW

Front-Panel Status LEDs:

“ACTIVE” – Provides indication that system is powered

“LOCKED” – Provides indication that the TS output is valid

Full MSR System control and status is accessed through either its RS-232C or USB-1 control ports via the supplied MS Windows based control application. A GMS remote control unit (RCU) is also available.

Physical

Dimensions: 8.55" (W) x 4.36" (D) x 4.0" (H)

21.7 cm x 11.07 cm x 10.16 cm

Weight: 32.07 oz (906 grams)

Environmental:

Operational Temperature: -10 to 70 deg C

Humidity: Up to 100% non-condensing

DC Power

DC Voltage Range: 9 -15 V

Power Consumption: 54 Watts (with 6 Tuner/Demods, powering 6 external BDCs)

Tuner/Demod Cards

Part Number: 710-A0619

Fully compliant with DVB-T ETS 300.744

COFDM RF Inputs

Number of Carriers: 2 K or 8 K

MSR Input Frequency: 49 – 862 MHz

User Control Input Frequency: translated to the input of the BDC's RF input band.

Frequency tuning resolution: 500 KHz

Frequency Acquisition and Recovery Range: +/- 350 KHz

Input Impedance: 75 Ohms

Noise Figure: Max: < 10 dB, Typical: <7 dB

System Frequency Accuracy: dependant on both MSR and BDC accuracy.

Bandwidth: Selectable 6,7,8MHz

Threshold**:	Single Input	Dual Input	Quad Input
	QPSK 1/2: <-91 dBm	QPSK 1/2: <-93.5 dBm	QPSK 1/2: <-95 dBm
	16-QAM 1/2: <-85 dBm	16-QAM 1/2: <-87.5 dBm	16-QAM 1/2: <-89 dBm
	64-QAM 1/2: <-80 dBm	64-QAM 1/2: <-82.5 dBm	64-QAM 1/2: <-84 dBm

Modulation

Modulation Type: COFDM w/QPSK or 16 QAM or 64 QAM

FEC: 1/2, 2/3, 3/4

Guard Intervals: 1/32, 1/16, 1/8, 1/4

COFDM Carriers: 2 K or 8 K Carriers

Block Down Converter Cards and Modules (Sold Separately)

See separate data sheets

Rack-Mount (Sold Separately)

7 User Notice

MSR Operational Limitations

Date: 9-17-2005

The MSR was originally released as an up to 8-channel receiver. GMS has been notified by the supplier of the diversity demodulator Integrated Circuit (IC) used in the MSR of certain operational limitations described in this document. These limitations are related to the number of diversity inputs that can be reliably used under different operational modes where one or more channels are going in and out of lock. The term "Lock" refers to the Carrier and Symbol tracking loops remaining locked onto the received signal. Note that these circuits will loose lock under very low signal-level conditions. Typically, somewhere <-95dBm. GMS's M.S. Windows control program provides visual indications of the status of these loops. Refer to "Carrier" and "Tuned" lock status indicators. Note that in many reception applications, this situation does not occur. If all channels in-use remain locked and all channels not in use remain unlocked the system will operate reliably with up to 8 channels.


For optimum error-free performance, under any input conditions, the MSR is currently limited to 6 installed input channels as described below. If you install channels 7 or 8 and only use the first 6 channels you will still take hits (interruptions in the transport stream) when one or more channels are going in and out of lock. For general operation, it is recommended that only 6 Tuner/Demod cards be installed.

The following table described the maximum number of channels that can be used for optimum error-free performance when one or more channels are going in and out of lock, which varies as a function of the Number of Carriers, Guard Interval and the RF Bandwidth:

Number of Carriers	Guard Interval	Maximum Number of Channels		
		6 MHz	7 MHz	8 MHz
8K*	$\frac{1}{4}$	6	6	6
	$\frac{1}{8}$	6	6	6
	$\frac{1}{16}$	6	6	6
	$\frac{1}{32}$	6	6	6
2K	$\frac{1}{4}$	5	5	6
	$\frac{1}{8}$	4	5	6
	$\frac{1}{16}$	2	2	3
	$\frac{1}{32}$	2	2	2

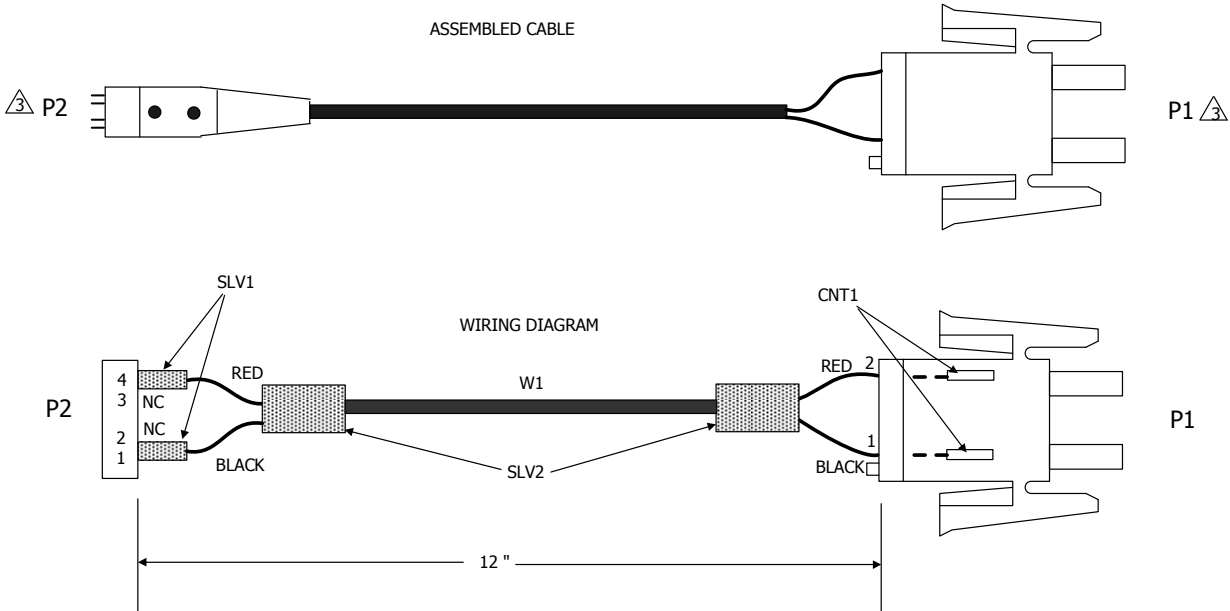
* GMS' Messenger C-OFDM Txs only support 2 K carriers.

The lowest channels must be used when limited to less than 6 channels. For example, when using 2 K carriers with 1/32 Guard Interval and 8 MHz RF Bandwidth, input channels #1 & #2 should be used.

- NOTES:
- 1. REFERENCE BOM 780-C0234X3 FOR PART REFERENCE DESIGNATORS (REFERENCED AS [] ON DRAWING) AND DESCRIPTIONS.
 - 2. BAG AND TAG FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0234X3 USING BEST COMMERCIAL METHOD.
-  LABEL CONNECTOR WITH REFERENCE DESIGNATION AS SHOWN USING BEST COMMERCIAL METHOD.

DRAFT

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
E0351X1	X1	INITIAL RELEASE	05/05/05 RJE	
E0351X2	X2	CHANGED CONNECTOR P1	05/23/05	
E0351X5	X3	REVERSED POWER & GND CONNECTIONS ON P2	08/29/05	

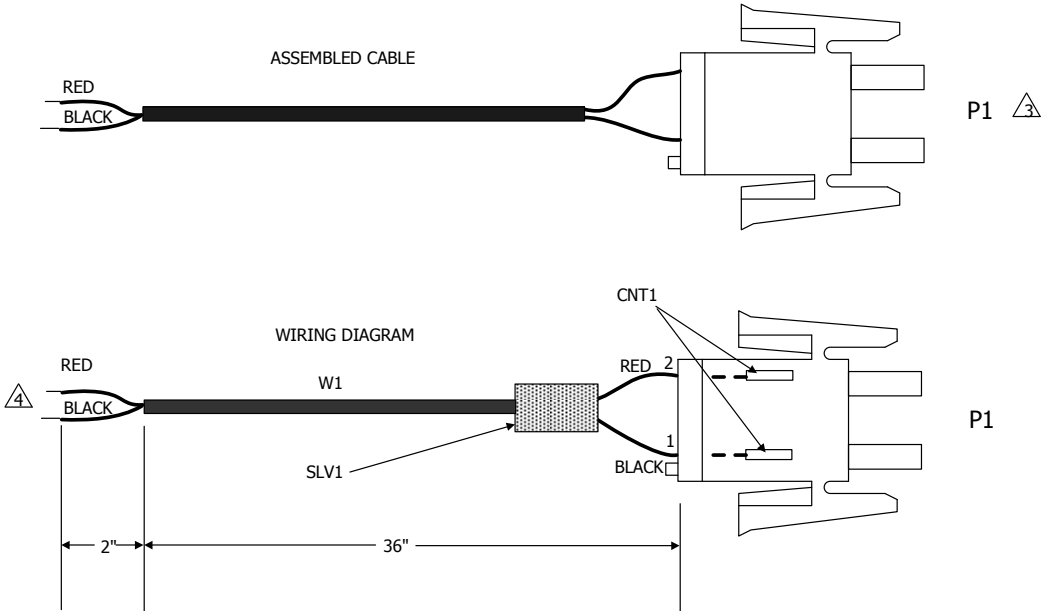


TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING		ENG/TECH		COBHAM GMS Products		DWG TITLE	
LINEAR		DRAWN		RJE		ASSY,CABLE,POWER,MSR	
X.X = ± 0.5		ENG		SIZE		DATE	
X.XX = ± 0.125		PROD		B		05/05/05	
X.XXX = ± 0.020		QC		SCALE		NONE	
						DWG NO	
						100-C0234X3	
						REV	
						X3	
						SHEET	
						1 OF 2	

- NOTES:
- 1. REFERENCE BOM 780-C0242X1 FOR PART REFERENCE DESIGNATORS (REFERENCED AS [] ON DRAWING) AND DESCRIPTIONS.
 - 2. BAG AND TAG FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0242X1 USING BEST COMMERCIAL METHOD.
 - 3. LABEL CONNECTOR WITH REFERENCE DESIGNATION AS SHOWN USING BEST COMMERCIAL METHOD.
 - 4. STRIP WIRES ENDS 0.25" AND TIN

DRAFT

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
E0351X2	X1	INITIAL RELEASE	05/23/05 RJE	



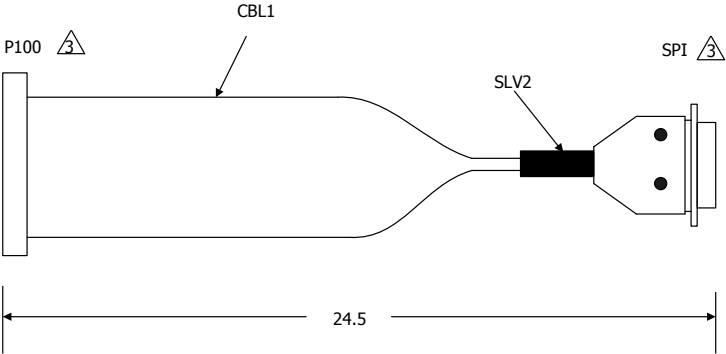
TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING		ENG/TECH		COBHAM GMS Products		DWG TITLE	
LINEAR		DRAWN RJE		SIZE B		DATE 05/23/05	
X.X = ± 0.5		ENG		DWG NO 100-C0242X1		REV X1	
X.XX = ± 0.125		PROD		SCALE NONE		SHEET 1 OF 2	
X.XXX = ± 0.020		QC					

Appendix C: Cable, SPI

- NOTES:
- 1. REFERENCE BOM 780-C0249X1 FOR PART REFERENCE DESIGNATORS (REFERENCED AS [] ON DRAWING) AND DESCRIPTIONS.
 - 2. BAG AND TAG FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0249X1 USING BEST COMMERCIAL METHOD.
 - 3. LABEL CONNECTOR WITH REFERENCE DESIGNATION AS SHOWN USING BEST COMMERCIAL METHOD.
 - 4. WIRING DIAGRAM ON PAGE 2

DRAFT


REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
E0351X3	X1	INITIAL RELEASE	09/28/05	



FROM	TO	FROM	TO
P100-13	SPI-1	P100-16	SPI-14
P100-19	SPI-2	P100-23	SPI-15
P100-29	SPI-3	P100-30	SPI-16
P100-27	SPI-4	P100-28	SPI-17
P100-25	SPI-5	P100-26	SPI-18
P100-9	SPI-6	P100-10	SPI-19
P100-7	SPI-7	P100-8	SPI-20
P100-5	SPI-8	P100-6	SPI-21
P100-3	SPI-9	P100-4	SPI-22
P100-1	SPI-10	P100-2	SPI-23
P100-33	SPI-11	P100-34	SPI-24
P100-15	SPI-12	P100-16	SPI-25
P100-23	SPI-13	SPI-13*	SPI-15*

* JUMPER WIRE 30 AWG

TABLE 1
WIRE LIST

TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING	ENG/TECH		 GMS Products		DWG TITLE	
	DRAWN R.ERVIN				CABLE,MSR,SPIB	
	LINEAR X.X = ± 0.5 X.XX = ± 0.125 X.XXX = ± 0.020	ENG	SIZE	DATE		DWG NO
PROD		B	06/08/05		100-C0249X1	X1
QC		SCALE NONE		SHEET 1 OF 4		

Appendix D: Optional Power Supply

Four Pin XLR Connector (Female)



Power Supply Assembly (GMS # 473-051)

Pin	Signal	Notes
1	GND	GND CONNECTION
2	No Connection	
3	No connection	
4	POWER 12VDC	Nominal +12VDC, 6.66 Amp draw max

Table 5 XLR Connector wiring